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MAJOR EARTH ELEMENTS GEOCHEMISTRY OF ASIRGARH VOLCANICS, BURHANPUR DISTRICT, M.P.

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ABSTRACT

Geochemistry is described as the tools and principles of chemistry to provide clarification the mechanisms at the back most important geological systems of the Earth. Scientists who studied the origin of chemical elements, their evolution, the classes of rocks and he studied also how they are created and changed by earth processes. The chemical analysis (SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, K_2O, TiO_2, P_2O_5, MnO,) for representative samples from the different stratigraphic levels have been carried out and their detailed geochemical characteristics and crystallization behavior were discussed for various major Earth elements. The data has been plotted and interpreted to understand the geochemical signatures of lava flows. The geochemical plotting are show the co-variation of elemental components that may give insight to magmatic processes such as partial melting, magma mixing, country rock contamination and fractional crystallization.

KEYWORDS: Fractional crystallization, Geochemistry, Harker variation diagrams, Major Earth elements.

INTRODUCTION:

Geochemistry is new branch of a much superior field of human attempt known as science and Science is definitely along with humanity's greatest achievement; without it, our modern development would not be possible. The term geochemistry was first used by the German-Swiss chemist Christian Friedrich Schonbein in 1838. In his paper, he predicted that the birth of a new field of study, that is geochemistry and he states that in his paper- a relative geochemistry has to be start on, previous to geochemistry be able to happen to geology, also previous to the unknown of the genesis of our planets and their inorganic matter may be exposed (Schonbein 1838).

Cameron and French (1977) defined the Basalt composition is that chemical composition which as crystallized at one atmosphere below standard situation will yield olivine, clinopyroxene, and plagioclase as the primary silicate phases. Clarke (1972) found that arrived at the following as the average percentage composition of the Earth's crust: SiO_2=59.71%, Al_2O_3=15.41%, Fe_2O_3=2.63, FeO=3.52%, MgO=4.36%, CaO=4.90%, Na_2O=3.55%, K_2O=2.80%, H_2O=1.52%, TiO_2=0.60%, P_2O_5=0.22%, (total 99.22%) and all the other chemical constituents take place only in very small quantities in the rock.

During this study, chemical analysis (SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, K_2O, TiO_2, P_2O_5, MnO,) for representative samples from the different stratigraphic levels have been carried out and their detailed geochemical characteristics and crystallization behavior were discussed for various major Earth elements. In this study, an attempt has been made to understand the various petrogenetic processes involved during emplacement and environment of crystallization through the chemical analysis and interpretation of the behavior of various chemical elements and their ratios with comparison of geochemical criteria used to define various chemical types. The geochemical plotting are drawn for to show the co-variation of elemental components that may give insight to magmatic processes such as partial melting, magma mixing, country rock contamination and fractional crystallization.

STUDY AREA:

Asirgarh area is situated at north eastern part of Burhanpur District. It is located about 20 km North West of the town of Burhanpur in Madhya Pradesh. The district of Burhanpur is situated in the state of Madhya Pradesh of central India. The study area lies between latitude 21° 11'- 21°52' N and longitude 75°55' – 76°30' E (Fig 1) located in toposheet no 55C/1 to C/8. The study area forming about 460m thick sequence of lava flow covering of an area of 4000 sq km in Burhanpur District of Madhya Pradesh. The study area is drained by Tapi River and Chhota Tawa River. The study area is situated in the valley of Narmada and Tapi River amidst the Satpura ranges, on the flat ground along the North bank of Tapi River.

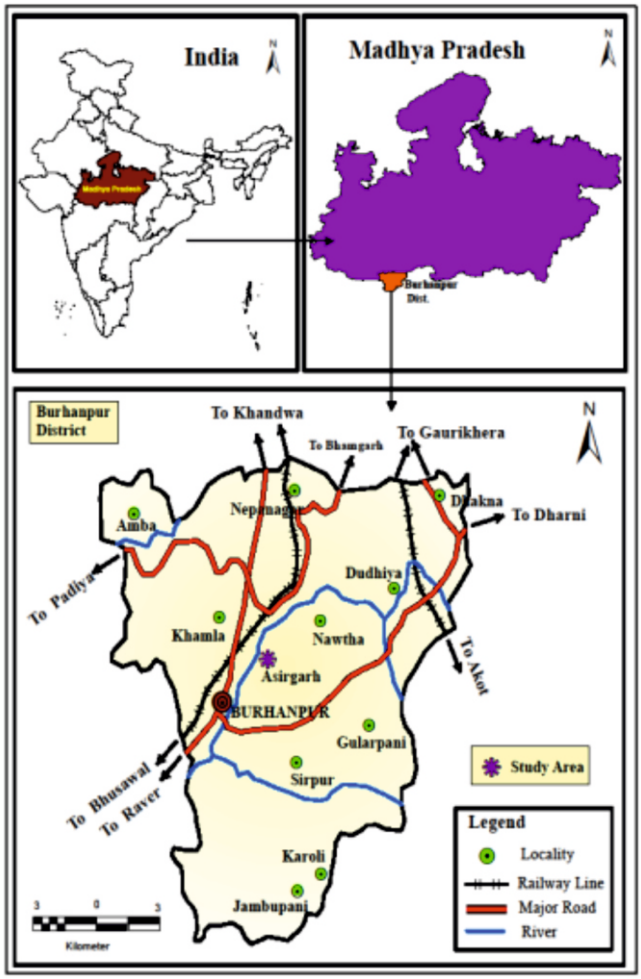

Fig. 1: Location map of Study Area

METHODS OF INVESTIGATION:

In favor of the geochemical investigation with respects to major, trace, rare earth elements representative 16 samples were selected from 11 field traverses. These geochemical samples are covering the entire stratigraphic sequence at the study area using Carliszesis microscope. This analysis is carried out by Inductivity Coupled Plasma Source Spectrometery (ICP) at the Royal Holloway, University of London U.K. using the technique developed by Walsh, (1979). The data has been plotted and interpreted to understand the geochemical signatures of lava flows.

Various models were proposed for understanding the genesis of these rocks. In geochemical analysis, all geochemical data were plotted and balancing of major ions and Piper diagram were plotted by using Hydro-chemical and Rock works software.

GEOLOGY OF THE AREA:

The major part of the study area is underlain by hard rock's consisting mostly of thick sequences of basaltic flows a part of Deccan trap of Malwa group. The traps are massive, compact, and fine to coarse grained, different chemical types, bluish, grey, and black to brown in color. Alluvium in the study area occurs as a narrow strip along the Tapi River and the Chhota Tawa River and these have individual extension. These alluviums generally comprise of clay, Silt, gravel's and occasionally cobbles. The area is covered by basaltic rocks. Among basalts, compact basalt, amygdaloidal basalt, vesicular basalt and giant plagioclase basalt are the basalt rock type which is observed in this formation. At places the compact basalt shows columnar jointing with parting and also shows one or two sets of joints.

GEOCHEMISTRY:

The major element variation plays an important role in considerate the nature and categorization of a variety of lava flows and their petro heritable relationship. The variation diagrams are useful for detection and categorization of igneous rock series and liquid lines of descent, forecast of the composition of the parental magma, detection of magmatic processes responsible for differentiation. The chemical composition of element in general differs with time and space as the basaltic magma or the parental material derived from the earth mantle. On the other hand the crystallization history of the lava flows will normally depend on the original composition of the melt, mode of emplacement, viscosity and volatile constituents present in it. In this study to understand various aspects of crystallization behaviors of lava flows with the help of element variation diagram. During this study, chemical analysis (SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, K_2O, TiO_2, P_2O_5, MnO,) for representative samples from the different stratigraphic levels have been carried out and their detailed geochemical characteristics and crystallization behavior were discussed for various major earth elements. In this study, an attempt has been made to understand the various petrogenetic processes involved during emplacement and environment of crystallization through the chemical analysis and interpretation of the behavior of various chemical elements and their ratios with comparison of geochemical criteria used to define various chemical types (Table 1). The geochemical plotting are drawn for the show the co-variation of elemental components that may give insight to magmatic processes such as partial melting, magma mixing, country rock contamination and fractional crystallization.

Table 1: Comparison of geochemical criteria used to define various chemical types

ASIRGARH AREA																
Fm	DAHINALA						ASIRGARH						AMBA			
CT	CT_2	CT_1	CT_3	CT_4	CT_1	CT_5	CT_2	CT_3	CT_1	CT_4	CT_1	CT_5	CT_1	CT_3	CT_4	CT_2
Flow No	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI
SiO_2%	50.14	50.58	49.324	51.21	50.32	51.84	50.64	50.52	50.64	50.26	52.12	51.53	49.13	50.64	49.26	51.24
Al_2O_3	12.28	13.42	12.56	12.85	12.14	12.42	12.52	12.72	12.58	12.51	12.98	12.32	12.46	12.87	12.54	12.38
Fe_2O_3	13.54	13.63	12.52	12.52	11.46	15.68	12.50	12.218	13.23	12.63	12.42	15.63	12.52	12.86	12.46	14.72
MgO	6.88	7.31	8.35	6.64	7.18	4.53	6.42	8.32	7.26	8.18	6.43	4.21	8.86	6.43	7.54	5.31
CaO	9.24	10.48	11.31	10.97	9.68	7.65	10.24	9.86	8.98	9.64	10.94	7.32	8.97	8.97	8.97	7.66
Na_2O	2.25	2.47	2.16	2.34	2.34	2.04	2.36	2.28	2.34	2.28	2.36	2.12	2.32	2.31	2.36	2.15
K_2O	0.78	0.59	0.26	0.78	0.68	1.21	0.78	0.56	0.68	0.72	0.58	1.26	0.68	0.54	0.73	1.24
TiO_2	1.88	1.73	2.08	1.78	2.18	2.86	1.68	1.43	2.12	1.62	1.78	2.41	1.42	1.72	2.08	2.78
P_2O_5	0.21	0.23	0.22	0.24	0.20	0.34	0.21	0.25	0.22	0.26	0.23	0.32	0.20	0.22	0.26	0.31
MnO	0.20	0.19	0.26	0.18	0.22	0.14	0.24	0.18	0.21	0.24	0.15	0.18	0.20	0.18	0.22	0.13

RESULT AND DISCUSSION:

Major element variation are divided into different types such as follows:

Alkali Silica Variation:

This variation diagram indicates the tholeiitic nature of lava flows in the study area with few lie in alkali basalt field. This variation diagrams has been plotted to understand the nature of basaltic magma and its genetic relationship. These variation diagrams are helpful for the categorization of volcanic rock and as well for differentiate between two categories of parental magma. This variation diagrams are found by Kuno's (1965) and later modified by Sugisaki and Tanaka (1971) and this alkali silica variation diagrams indicate that the basalts in the study area can be grouped into high potash and low potash theoretic fields with few samples showing alkali basalt field. Silica, quartz tholeiitic character of the study area can be believed to be beginning the normative mineralogy. In the total alkali (Na_2O + K_2O) vs. silica (SiO_2) diagrams (Le Bas et al., 1986; Le Maitre, 2002) the samples plot in the field of basalt showing a high-alkaline composition (Fig. 1).

HARKER VARIATION DIAGRAM6S:

In Harker variation diagrams the variation of major and minor oxides abundances verses SiO_2 indicates the thought to be an indication of the evolved character of a magmatic system. In this variation diagrams SiO_2 Vs major and trace element have been plotted to understand the petro genetic significant of various lava flows expose in study area. Most of the major elements (Al_2O_3, Fe_2O_3, CaO, TiO_2, P_2O_5, K_2O) show positive correlation with SiO2 indicating the dominance of fractional crystallization. The Al_2O_3 variation diagram indicates the role of plagioclase in fractionation and the most of the samples are grouped into subalkali field showing the dominance of fractional crystallization with minor amount of crystal contamination. The MgO variation indicates olivine, clinopyroxene and magnetite removal during the fractional trend. The Na_2O, K_2O, CaO (Fig.6) variation diagrams with a specific trend demarcate fractional crystallization process with crystal contamination. The TiO_2 variation (Fig 5) indicates the role of olivine and clinopyroxene in the crystallization processes with the presence of magnetite as the fractionating material. However, few samples fall in the alkali field showing a trend of enriched source with decreasing partial melting (Fig. 3, 4). This study indicates the supremacy of cryastal fractionation process from aphyric and mafic phyric flows to plagioclase phyric and GPB flows.

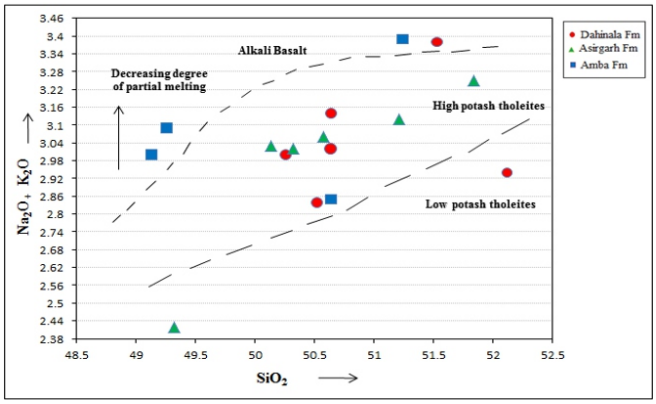

Fig. 2: Variation of Na_2O+K_2O Vs SiO_2 indicating the Tholeiitic nature of basalt with fractional crystallization trend.

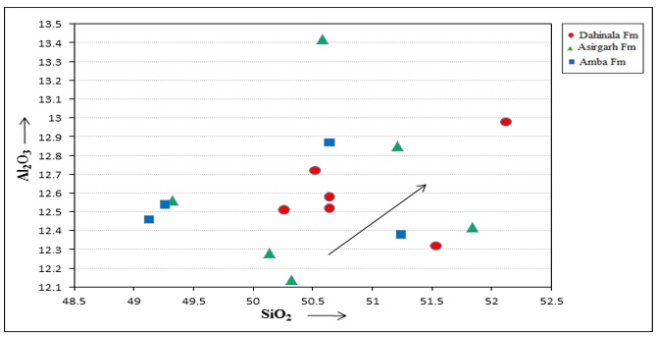

Fig. 3: Harker variation diagram

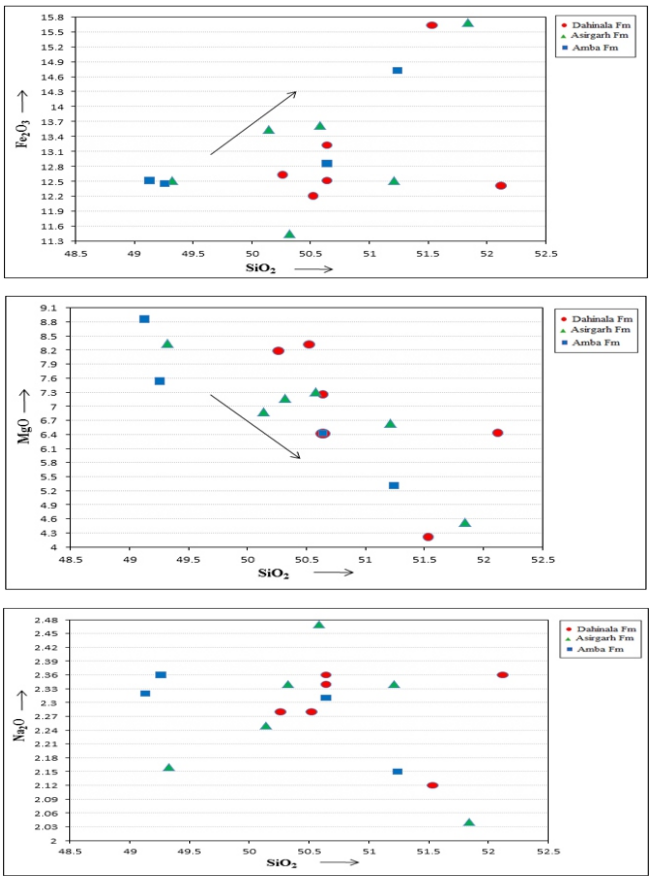

Fig. 4: Harker variation diagram

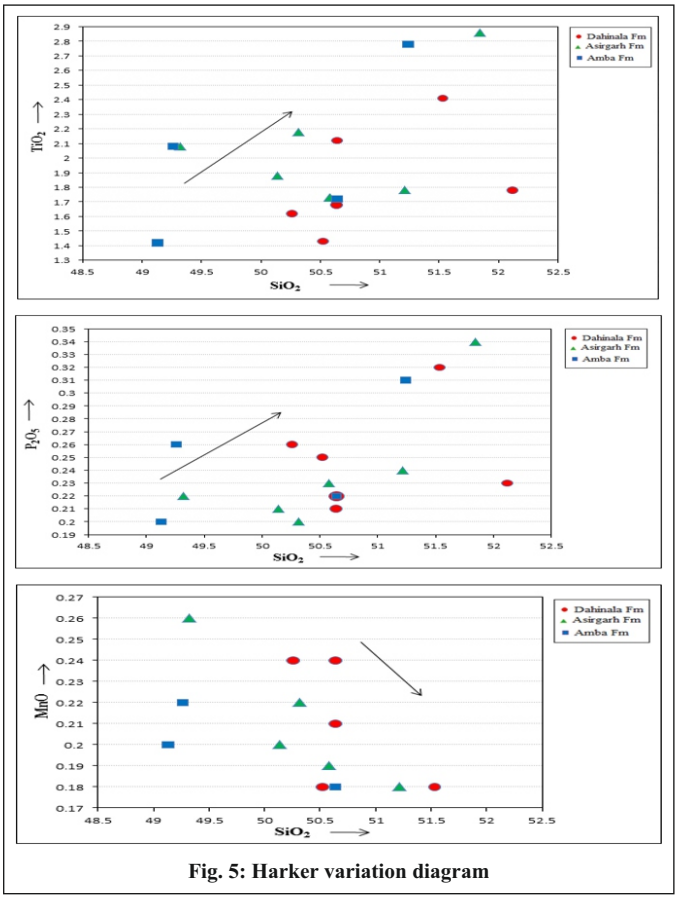

Fig. 5: Harker variation diagram

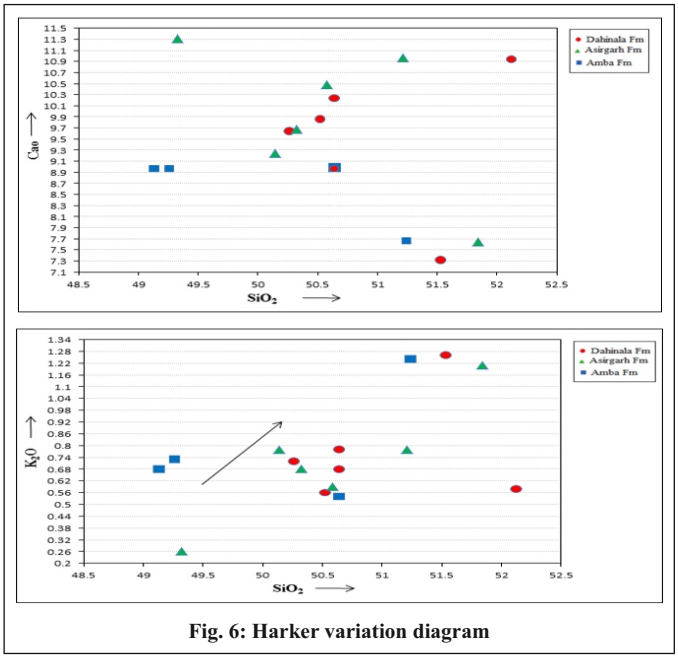

Fig. 6: Harker variation diagram

CONCLUSION:

The geochemical analysis of rock samples carried out by Inductivity Coupled Plasma Source Spectrometry (ICP). In favor of the geochemical investigation with respects to major, trace, rare earth elements, representative 16 samples were selected from 11 field traverses. These geochemical samples cover the entire stratigraphic sequence of the study area using ICP-MS techniques. The data has been plotted and interpreted to understand the geochemical signatures of lava flows. The geochemical plotting are show the co-variation of elemental components that may give insight to magmatic processes such as partial melting, magma mixing, country rock contamination and fractional crystallization. The geochemical activities of study area have been evaluated based on major, trace and REE properties of samples using geochemical technique. From Alkali silica variation diagrams the Asirgarh basalts are high-K alkali basalt (Tanaka 1971). The Harker variation diagram with number of variation indicates the dominance of crystal fractionation associated with minor degree of crustal contamination, crustal accumulation and partial melting process with varying degree. Most of the major elements like Al_2O_3, Fe_2O_3, CaO, TiO_2, P_2O_5, K_2O show positive correlation with SiO2 indicating the dominance of fractional crystallization. The Na_2O, K_2O, CaO variation diagrams with a specific trend demarcate fractional crystallization process with crystal contamination. The geochemical major earth elements investigation have shows significant variation in certain geochemical parameters such as MgO, TiO_2, P_2O_5, etc and led to the establishment of a comperensive flow stratigraphy and geochemical behavior of lava flows of the Burhanpur region.

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